Title: Changepoint detection versus reinforcement learning: Separable neural substrates approximate different forms of Bayesian inference.

Authors: Wolfgang M. Pauli[1*] and Matt Jones[2*]

Affiliations: [1]Humanities and Social Sciences, California Institute of Technology, Pasadena, CA 91125, USA

[2]Department of Psychology and Neuroscience, University of Colorado Boulder, 345 UCB Boulder, CO 80309.

***Correspondence to:** mcj@colorado.edu

Abstract: Adaptive behavior in even the simplest decision-making tasks requires predicting future events in an environment that is generally nonstationary. As an inductive problem, this prediction requires a commitment to the statistical process underlying environmental change. This challenge can be formalized in a Bayesian framework as a question of choosing a generative model for the task dynamics. Previous learning models assume, implicitly or explicitly, that nonstationarity follows either a continuous diffusion process or a discrete changepoint process. Each approach is slow to adapt when its assumptions are violated. A new mixture of Bayesian experts framework proposes separable brain systems approximating inference under different assumptions regarding the statistical structure of the environment. This model explains data from a laboratory foraging task, in which rats experienced a change in reward contingencies after pharmacological disruption of dorsolateral (DLS) or dorsomedial striatum (DMS). The data and model suggest DLS learns under a diffusion prior whereas DMS learns under a changepoint prior. The combination of these two systems offers a new explanation for how the brain handles inference in an uncertain environment.

One Sentence Summary: Adaptive foraging behavior can be explained by separable brain systems approximating Bayesian inference under different assumptions about dynamics of the environment.